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THIN FILM COIL AND METHOD OF FORMING THE SAME, AND THIN FILM MAGNETIC HEAD AND METHOD OF MANUFACTURING THE SAME

BACKGROUND

[0001] The invention relates to a thin film coil spirally wound, a method of forming a thin film coil, a thin film magnetic head including a thin film coil, and a method of manufacturing a thin film magnetic head.

[0002] Recently, improvement in performance of a thin film magnetic head has been sought in accordance with an increase in a surface recording density of a magnetic recording medium (hereinafter referred to simply as a "recording medium"), such as a hard disk. Widely used as the thin film magnetic head is, for example, a combined thin film magnetic head comprising a combination of a recording head having an inductive magnetic transducer for use in recording and a reproducing head having a magnetoresistive element for use in reproducing. The recording head is provided with a thin film coil which generates a magnetic flux to record data on the recording medium, and the thin film coil is one determinant factor of a magnetic path length closely related to the performance of the recording head. The magnetic path length corresponds to the length between a surface of the thin film magnetic head to be faced with the recording medium (hereinafter, the surface is referred to as an "air bearing surface") and the position at which there are coupled two magnetic layers which are disposed with the thin film coil in between and each contain a magnetic pole. It is generally required that the magnetic path length be short. The reason is as follows. A short magnetic path length allows improvement in characteristics such as the flux rise time and nonlinear transition shift (NLTS), thus achieving improvement in the performance of the recording head. On the other hand, the thin film coil is required to exhibit lower electrical resistance.

[0003] General methods of forming such a thin film coil include a method utilizing photolithographic technique (see Japanese Unexamined Patent Application Publication No. 2001-60307, for example). Specifically, this method involves the following procedure. First, a substrate having a metal underlayer film formed thereon is coated with a photoresist film, on which a spiral resist pattern is then formed by use of photolithography. Then, a spiral conductive film is formed by means of plating using the metal underlayer film so as to fill a region between windings in the spiral resist pattern. Then, after the removal of the resist pattern, the metal underlayer film is removed by use of ion milling or the like, and an exposed gap in the conductive film is filled with an organic insulator such as a resist or an inorganic